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Army Aviation Ammunition and Gunnery Survey
Volume 1: Executive Summary

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The research was conducted to compile an empirical data base on the current training in active U.S. Army (AA) and National Guard (NG) attack helicopter units and to estimate the resource requirements for qualifying and sustaining adequate levels of aviator gunnery proficiency. Separate versions of the Ammunition and Gunnery Survey were distributed to a sample of AA and NG aviators (Form A) and unit commanders (Form B). The aviators returned 810 (41% return rate) usable Form A surveys. The unit commanders returned 127 (35% return rate) usable Form B surveys. This report presents a summary of the major results of the survey data. The primary conclusions are (a) a substantial number of attack helicopter units are unable to meet training standards with the resources currently available to them, (b) gunnery ranges have inadequate scoring methods or are not readily available to many units, (c) flight simulators are being used only moderately by AA aviators for gunnery training, and (d) the current ammunition authorization
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approximates the minimum number of rounds needed to qualify and sustain the average aviator's gunnery skills. The limitations of the survey data and the need for experimental studies of training effectiveness are also discussed.

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FOREWORD

The Army Research Institute Aviation Research and Development Activity (ARIARDA) at Fort Rucker, Alabama, is responsible for providing timely research and development support in aircrew training for the U.S. Army Aviation Center (USAAVNC). Research and development activities are conducted in-house and augmented by contract support as required. This technical report documents contract work performed by ARIARDA in support of the Directorate of Gunnery and Flight Systems (DGFS) at the USAAVNC.

The success of the U.S. Army attack helicopter mission depends on the effectiveness of the unit helicopter gunnery training programs. In turn, the effectiveness of the training programs depends on the optimal use of the expensive resources that are required to train and sustain proficient attack aviators: personnel, flight hours, ammunition, gunnery ranges, and training devices. This report documents the results of a survey of active Army and National Guard aviators and unit commanders that was conducted to address three primary gunnery training issues: the minimum requirements for and current use of ammunition, the availability and use of gunnery ranges, and the availability and use of helicopter simulators. In addition, the survey addresses other areas of interest in the management of the attack aviation force.

The results of the Ammunition and Gunnery Survey are being reported in two volumes. Volume I is a summary of the major results of the research and Volume II is a detailed final report on the survey data. The major findings of this research have been briefed to the Deputy Commanding General for Training, Training and Doctrine Command; the Director of Training Department of the Army Management Office; the Commanding General USAAVNC; Director, DGFS; and at the Helicopter Gunnery Manual User's Conference.

EDGAR M. JOHNSON
Technical Director

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The work reported herein was performed at Fort Rucker, Alabama, by personnel from the Directorate of Gunnery and Flight Systems (DGFS), the Army Research Institute Aviation Research and Development Activity (ARIARDA), and Anacapa Sciences, Inc. The authors would like to thank the following individuals who have contributed to this research effort.

From DGFS, COL Merwyn L. Nutt, the former Director of DGFS, participated in the initial development and pretesting of the Ammunition and Gunnery (A & G) Survey. CW3 Samuel S. Sill assisted in the development and pretesting process. SFC Arthur Miller assisted in the development, pretesting, data collection, and data entry effort before transferring to another division of DGFS. Finally, SSG Christopher Rummel coordinated the completion of the data entry effort and provided research support in tabulating open-ended responses.

Mr. Charles A. Gainer, ARIARDA Chief, served as the Contracting Officer's Technical Representative throughout the project and provided guidance on many aspects of the research. Mr. Larry Murdock, ARIARDA computer programmer analyst, developed the data entry programs, supervised the data entry and verification, and conducted the required analyses of the data base.

Dr. Kenneth D. Cross, Anacapa program manager and project director, was responsible for the technical development of the A & G Survey. Dr. Cross also reviewed the data analyses and final report. Dr. George L. Kaempf, Anacapa senior scientist, conducted a critical review of an earlier draft of this report and provided a number of insights into the training of attack aviators, particularly on range and gunnery operations, and on the use of simulators for training. Finally, Ms. Nadine McCollim, Anacapa Technical Documentation Specialist, has had the responsibility for producing all the survey originals, briefing materials, and reports for the entire project.

ARMY AVIATION AMMUNITION AND GUNNERY SURVEY
VOLUME I: EXECUTIVE SUMMARY

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GLOSSARY OF ACRONYMS

AA	-	Active Army
A&G	-	Ammunition and Gunnery
ARIARDA	-	Army Research Institute Aviation Research and Development Activity
ASI	-	Anacapa Sciences, Inc.
CALFEX	-	Combined Arms Live-Fire Exercise
CMS	-	AH-64 Combat Mission Simulator
DA	-	Department of the Army
DA CIR	-	Department of the Army Circular
DAMO-TR	-	Department of the Army Management Office - Director of Training
DGFS	-	Directorate of Gunnery and Flight Systems
ECAS	-	Enhanced Cobra Armament System
EUSA	-	8th U.S. Army
FFAR	-	Folding Fin Aerial Rocket
FM	-	Field Manual
FORSCOM	-	Forces Command
FS	-	Flight Simulator
FWS	-	AH-1 Flight and Weapons Simulator
FY	-	Fiscal Year
HE	-	High Explosive
IP	-	Instructor Pilot
IQR	-	Interquartile Range
JAAT	-	Joint Air Attack Team
MC	-	Modernized Cobra
MOD	-	AH-1S Modified Model
MPRC	-	Multi-Purpose Range Complex
NG	-	National Guard
NVD	-	Night Vision Device
PROD	-	AH-1S Production Model
SME	-	Subject Matter Expert
STRAC	-	Standards in Training Commission
TO&E	-	Table of Organization and Equipment
TOW	-	Tube-Launched, Optically-Tracked, Wire-Guided
TRC	-	Training Readiness Condition
UH1FS	-	UH-1 Flight Simulator
USAAVNC	-	U.S. Army Aviation Center
USAREUR	-	U.S. Army, Europe
UT	-	Unit Trainer

ARMY AVIATION AMMUNITION AND GUNNERY SURVEY
VOLUME I: EXECUTIVE SUMMARY

INTRODUCTION

The successful accomplishment of the U.S. Army attack helicopter mission depends upon the effectiveness of the unit helicopter gunnery training programs. Currently, the Army delegates to each unit commander the authority to develop, implement, and evaluate a training program to qualify and sustain the unit aviators' proficiency in aerial gunnery. That is, each unit commander is required to tailor a gunnery training program to meet the specific needs of the unit's personnel and to fulfill the unit's mission. As a consequence of this policy, however, the gunnery training programs vary in content and quality from one unit to another.

The accomplishment of effective unit training requires not only careful planning and execution, but also a large expenditure of resources (e.g., ammunition, flight hours, and gunnery range time). In response to the need for standardization and because of the competition for training resources, the Army formed the Standards in Training Commission (STRAC) in 1982 to (a) develop standards for training on all Army weapons systems, (b) develop notional training programs to meet the standards, (c) integrate existing training devices and simulators into the training programs, and (d) determine the amounts of ammunition required to support the training programs for each branch (FY 86 STRAC Evaluation Final Report, 1987).

In 1985, STRAC published the Standards in Weapons Training manual as Department of the Army Circular (DA CIR) 350-85-4. This manual establishes the training standards for units on the basis of their Training Readiness Condition (TRC) and specifies the amount of ammunition that should be expended to meet the standards. For example, STRAC authorizes 160 rounds of 2.75-inch Folding Fin Aerial Rockets (FFARs) per airframe for TRC A units, 150 FFARs per airframe for TRC B units, and 80 FFARs per airframe for TRC C units. However, all units do not always receive the full authorization of ammunition; in other cases, units may not expend their full allocation because of internal (e.g. maintenance) or external (e.g., limited access to ranges) factors.

In October 1986, the U.S. Army Aviation Center (USAAVNC) published a Field Manual (FM 1-140) entitled Helicopter Gunnery to assist unit commanders in establishing an effective gunnery training program. The manual explains fundamentals of ballistics and gunnery techniques, describes the aerial weapons systems on all attack helicopters, and discusses the administrative and logistical considerations required for the training program. Within the constraints imposed by STRAC, FM 1-140 establishes the gunnery tasks and performance criteria for aviators to qualify on and sustain individual, crew, team, and CALFEX/JAAT (Combined Arms Live-Fire Exercise/Joint Air Attack Team) proficiency. The manual presents flexible gunnery tables that delineate the flight conditions, types of targets, ranges to targets, type and amount of ammunition to be fired, and the desired target effect for each level of qualification. Because the tables are flexible, the unit commander can select target arrays that are appropriate for his aircraft, mission, and gunnery resources in developing the unit's gunnery training program.

Despite the attempt by STRAC to standardize the gunnery training requirements for each branch of the Army, the escalating costs of ammunition and diminishing resources have resulted in an ongoing evaluation of ammunition allocations. In December 1986, USAAVNC representatives participated in a meeting at Department of the Army (DA) Headquarters to obtain the DA Management Office Director of Training's (DAMO-TR) approval of the STRAC ammunition standards and strategies for the Aviation Branch. The initial indication from the DAMO-TR was that the FFAR authorization would be cut by approximately 50%. The DAMO-TR agreed to delay the reduced allocation of ammunition for one year to permit the Aviation Branch to collect the data needed to justify its ammunition requests. In January 1987, the Commanding General of the USAAVNC directed that a survey be administered worldwide to attack helicopter aviators and unit commanders in the active Army and National Guard to determine the needs of Army aviation in training and sustaining the required gunnery skills.

REPORT ORGANIZATION

The results of the survey are being reported in two volumes. Volume I, the Executive Summary, presents an overview of the major results and is intended for early distribution. In the Executive Summary, a sample of data tables and figures are presented to show the types of information that can be found in the final report. Volume II, the final report, presents a detailed description of the survey results and is intended for audiences interested in in-depth analyses

of the data. The final report presents complete data tables and figures, and includes copies of the survey materials as appendixes.

Volume I, the Executive Summary of the survey research, is organized into the following sections:

- survey purpose,
- survey development,
- survey sample,
- survey results and discussion, and
- summary and conclusions.

SURVEY PURPOSE

The survey research is designed to provide an empirical data base of information needed to address three major problem areas. First, the research is intended to document the current utilization of ammunition in aviation gunnery training and to compile estimates of the amounts of ammunition required to maintain specified STRAC readiness conditions. In addition to formulating the ammunition allocation requirements, the resulting data base will be used to develop a new gunnery training manual.

The second major problem area is the lack of adequate ranges for training and qualifying unit aviators. Many of the ranges presently available to aviation unit commanders lack the targetry, scoring devices, and space required for effective training. Furthermore, field units report that limited access to the ranges at desirable training times or for sufficient periods of time inhibit the gunnery training and make it difficult to maintain the required readiness conditions. The survey research is intended to document the availability, type, and utility of gunnery ranges currently in use by Army aviation units.

The final major problem area is the lack of empirical data on the utilization of flight simulators and their effectiveness for weapon systems training. Theoretically, flight simulators can reduce the impact of the first two problems. That is, weapons training can be conducted without physical ranges and without incurring ammunition costs. However, there are no systematic data about which tasks can be trained effectively in simulators, the amount of simulator training that is most cost-effective, nor the extent to which flight simulator training can offset the need for firing weapons in the aircraft. This problem is compounded by the fielding of a single configuration of the AH-1S Flight and Weapons Simulator (FWS) that is used by unit aviators who fly

different configurations of AH-1 helicopters (e.g., AH-1G, AH-1S Modified (MOD), and AH-1S Production (PROD) models). The FWS is configured like the AH-1S Fully Modernized (MC) helicopter. The survey research is designed to collect information about the utilization of flight simulators for aerial weapons training.

In addition to the major problem areas, the survey includes questions about the management of the attack aviation force (e.g., aviator demographic characteristics) and on ancillary gunnery issues (e.g., door gunnery).

SURVEY DEVELOPMENT

Survey development began with a review of the relevant literature, the current aerial gunnery training manual (FM 1-140), the STRAC manual (DA CIR 350-85-4),and a previous STRAC questionnaire. The USAAVNC Directorate of Gunnery and Flight Systems (DGFS) Study Group then delineated the Essential Elements of Analysis for the survey. Approximately 100 preliminary survey items were drafted in the following ten topic areas covered by the Essential Elements of Analysis:

- personal data about the respondent,
- military experience of the respondent,
- flight experience of the respondent,
- present duty assignment of the respondent,
- suitability of current gunnery training publications,
- weapon systems on the aviator's primary aircraft,
- ammunition allocated and fired during the 1987 training year,
- utilization of gunnery range facilities,
- utility of flight simulators for gunnery training and qualification, and
- door gunnery training.

The preliminary survey items were administered to approximately 50 attack aviators by DGFS personnel. The results of this pretest were used to produce a second draft of the Ammunition and Gunnery (A & G) Survey. The second draft was divided into two forms: Form A for the unit aviators and Form B for the unit commanders. Many of the items on the two forms are similar in content, but the unit aviator was instructed to respond to the items with respect to himself and the unit commander was instructed to respond to the items with respect to his entire unit, except for personal data and experience of the respondent.

An extensive pretest of the second draft of the survey was scheduled but had to be cancelled because of administrative problems at the participating installations. A complete pretest could not be rescheduled because of the one-year suspense stipulated by the DAMO-TR. As a consequence, the survey was developed without benefit of further pretesting. DGFS personnel, acting as aviation and gunnery subject matter experts (SMEs), and Army Research Institute Aviation Research and Development Activity (ARIARDA) personnel, acting as survey development and analysis SMEs, reviewed and edited the final versions of the survey forms and prepared the required ancillary materials (e.g., letters of instruction). The surveys were subsequently approved by the U.S. Army Soldier Support Center and then reproduced for administration.

Form A contains 68 items that address nine of the ten topic areas listed above; no questions are posed to the unit aviators about door gunnery. Form B contains 78 items that address all ten topic areas. Some of the items ask for objective data that can be obtained from records, and other items ask for subjective opinions from the respondent. The surveys are much more comprehensive than the number of items indicates. That is, many items have multiple sections or require a series of responses. Although all the items would not apply to all respondents, there are 472 codable responses on Form A and 644 codable responses on Form B. In addition, both forms have several open-ended response items.

SURVEY SAMPLE

The A & G Survey was distributed to a sample of Active Army (AA) and National Guard (NG) aviators and commanders in attack helicopter units. Form A of the survey was distributed to 1190 AA and 806 NG attack aviators. Form B of the survey was distributed to 202 AA commanders and 160 NG commanders of varying levels of attack helicopter units (e.g., troop, company, battalion, and brigade). The majority of the surveys were mailed to installation points-of-contact for administration. The remainder of the surveys were distributed or administered by DGFS personnel conducting visits to field units, primarily to U.S. Army, Europe (USAREUR) units in the Federal Republic of Germany.

Response Rates

Considering the length of the surveys and the relatively short suspense that was required to meet the DAMO-TR's deadline, the response rate for both forms was very adequate. Aviators returned 810 usable Form A surveys for an overall 41% response rate. In addition to the usable surveys; 184 Form A surveys were returned unused or incomplete. The response rate from all major commands was at least 30%, while the response rate from USAREUR aviators was 78%; the on-site data collection by DGFS personnel probably contributed to the very high USAREUR response rate. Of the 810 aviators, 39.1% belonged to Forces Command (FORSCOM), 27.2% belonged to USAREUR, 1.9% belonged to the Eighth Army (EUSA), and 31.9% belonged to the NG.

Unit commanders returned 127 usable Form B surveys for an overall 35% response rate; 35 Form B surveys were returned unused or incomplete. None of the ten EUSA surveys were returned. The rate of responding from the other major commands ranged from 29% to 57%. Again, the response rate from USAREUR was the highest. The percentage of the 127 unit commanders that belonged to each major command are similar to the aviator percentages: 37% belonged to FORSCOM, 26.8% belonged to USAREUR, and 36.2% belonged to the NG.

Response Rate Reporting

There are substantial differences in the number of respondents who answered many of the survey questions. In some cases, a question does not apply to all respondents and, in other cases, some respondents simply did not answer a question. In reporting the data, the number of respondents (e.g., $n = 120$) who answered a particular question will be given if it is less than the total sample (e.g., 127 unit commanders).

Component Division

The data were analyzed separately for the AA and NG respondents because of the major differences in the types of aircraft flown, training resources and standards (e.g., most AA units are TRC A or B while most NG units are TRC C), and unit mission. Of the aviator sample, 545 respondents identified themselves as AA and 259 identified themselves as NG; 6 respondents did not identify their component. Of the commander sample, 80 respondents identified themselves as AA and 43

identified themselves as NG; 4 respondents did not identify their component.

Aviator Demographics

The demographic characteristics of the Form A respondents are presented in Table 1. The majority of aviators are Warrant Officers rather than Commissioned Officers. The majority of AA aviators are in grades WO1 and CW2, while the NG aviators are more evenly divided among the Warrant Officer grades. With the exception of number of years on active duty, the NG aviators have considerably more experience in terms of age, years of flight duty, and combat experience.

Table 1

Aviator Sample Demographic Characteristics

	Active Army	National Guard
Rank: Number (Percent)		
WO1 - CW2	347 (63.7)	111 (42.9)
CW3 - CW4	116 (21.3)	116 (44.8)
1LT - 2LT	66 (12.1)	19 (7.3)
CPT - MAJ	16 (2.9)	13 (5.0)
Age		
Median	28	38
Range	20 - 46	23 - 51
Years on Active Duty		
Median	7.2	4.0
Range	1.1 - 24.4	0.0 - 26.2
Years on Flight Duty		
Median	3.8	11.3
Range	0.0 - 21.2	0.0 - 29.8
Combat Experienced		
Number (Percent)	52 (9.5)	65 (25.1)

Note: The number of respondents were 545 Active Army (AA) and 259 National Guard (NG) except for Age (n = 540 AA and 254 NG).

However, 85.6% (n = 536) of the AA aviators reported themselves as crew qualified while only 61.5% (n = 247) of the NG aviators reported themselves as crew qualified. The results were similar, although lower, for self-reports of team qualification: 59.4% (n = 532) of AA aviators and 43.7% (n = 245) of NG aviators reported themselves as team qualified.

Unit Commander Demographics

The demographic characteristics of the Form B respondents are presented in Table 2. The majority of the commander respondents held the rank of Captain or Major. The ranks also reflect the primary duty position held by the majority of the respondents. Among AA respondents (n = 78), 17.9% were listed as battalion or brigade commanders, 70.5% were

Table 2

Commander Sample Demographic Characteristics

	Active Army	National Guard
Rank: Number (Percent)		
1LT - 2LT	8 (10.3)	7 (16.7)
CPT - MAJ	56 (71.7)	32 (76.2)
LTC - COL	14 (18.0)	3 (7.1)
Age		
Median	30	36
Range	23 - 47	23 - 48
Years on Active Duty		
Median	8.3	4.0
Range	2.3 - 25.0	0.0 - 13.7
Years on Flight Duty		
Median	6.0	7.0
Range	1.7 - 21.5	1.3 - 19.7
Combat Experienced		
Number (Percent)	14 (17.5)	8 (18.6)

Note: The number of respondents were 545 Active Army (AA) and 259 National Guard (NG) except for Rank and Years on Flight Duty (n = 78 AA and 42 NG).

listed as company or troop commanders, and 11.5% were listed as holding other positions within the unit (e.g., Executive Officer, Operations Officer, Platoon Leader). Among the NG respondents (n = 42), 7.1% were listed as Battalion or Brigade Commanders, 71.4% were listed as Company or Troop Commanders, and 21.4% were listed as holding other positions.

The differences in experience observed between AA and NG commanders was much smaller than between the aviators in each component. NG commanders were somewhat older, but AA commanders had nearly twice as much time on active duty. There were only very small differences in years of flight duty and the percentage who had combat experience.

Unit Characteristics

Of the AA commanders, 61.2% reported that their units were TRC A, 15% reported TRC B, and 1.3% reported TRC C; however, 22.5% did not respond. Of the NG commanders, 4.7% reported that their units were TRC A, 4.7% reported TRC B, and 74.4% reported TRC C; 16.2% did not respond. The relatively large percentage of commanders who did not respond to this item may be attributed to the new Army Table of Organization and Equipment (TO&E). Under the "J" series TO&E, company commanders are not required to maintain training reporting records and would not necessarily know their TRC status. In addition, many of the respondents who held positions other than unit commander may not know the unit's TRC level.

The commanders were asked to indicate the types of attack aircraft that were assigned to their units; this item permitted multiple responses so the totals add to more than 100%. As shown in Table 3, the majority of AA units were assigned the AH-1S (MC) Fully Modernized Cobra and the majority of NG units were assigned the UH-1 C/M helicopter. At the time that the survey was administered, the AH-1S Production Model and the AH-64A Apache were assigned only to AA units.

SURVEY RESULTS AND DISCUSSION

There is an extremely large number of possible analyses of the A & G Survey data that can be conducted because of the hundreds of codable items on each form and the many ways in which this extensive data base can be partitioned. Part of the benefit of establishing a data base is to permit questions that arise after the data are collected to be answered

Table 3

Number and Percentage of Component Units Assigned Each Aircraft Type and Series

	Active Army (n = 78)		National Guard (n = 41)	
Aircraft Type and Series	Nr	%	Nr	%
AH-1G	0	0	1	2.4
AH-1S (ECAS)	8	10.3	1	2.4
AH-1S (MC)	45	57.7	1	2.4
AH-1S (MOD)	15	19.2	16	39.0
AH-1S (PROD)	8	10.3	0	0
AH-64A	8	10.3	0	0
UH-1 C/M	1	1.3	23	56.1
UH-1H	14	17.9	11	26.8

Note: The following abbreviations are used in Table 3: Nr = number of commanders responding who indicated that each type of aircraft was assigned to their unit; ECAS = enhanced Cobra armament system; MC = modernized Cobra; MOD = modified; PROD = production. The % column may total more than 100 since a unit may be assigned more than one type or series of aircraft.

without conducting additional research. The results of the A & G Survey that address the major problem areas of interest in this project are summarized in the following sections:

- FY87 training characteristics,
- gunnery ranges,
- flight simulators, and
- estimated training requirements.

The results are presented using the appropriate descriptive or inferential statistics for each variable. For those items that are categorical (e.g., items that provide only a yes or no response), only the number and percentage of respondents are reported. For most items, the median (Mdn) and interquartile range (IQR) are reported as measures of central tendency and dispersion because of the highly skewed

distributions of responses. The median is the 50th percentile (i.e., middle) score and the interquartile range includes the scores between the 25th and 75th percentiles (i.e., the endpoints of the middle half of the scores) of a distribution. These statistics describe the responses without being highly biased by extreme scores. An example of an extreme score for all aviators would be the number of annual flight hours of an instructor pilot (IP).

If appropriate and interpretable, the arithmetic mean and standard deviation (SD) are reported instead of the Mdn and IQR; for example, ratings of the training value of a simulator on a seven-point scale are reported using the mean and SD of the responses. Finally, statistical tests are used to determine if significant differences exist in a variable between two or more subsamples of respondents. For example, a t-test is used to determine if there are significant differences in the perceived training value of the FWS between aviators who fly different AH-1S models.

FY87 Training Characteristics

Flight hours. Table 4 shows the number of respondents who flew each type of helicopter during Fiscal Year 1987 (FY87), and the median number of flight hours that were logged in each aircraft type. Respondents were permitted to indicate the number of flight hours that they logged in their primary and secondary aircraft, if any. Unit commanders logged the most flight hours in OH-58 Aeroscouts, AA aviators flew most often in one of the AH-1S series, and NG aviators flew most often in the UH-1C/M models. As expected, the median number of flight hours was generally much higher for the AA respondents than for the NG respondents.

Ammunition fired. Table 5 shows the number of aviators who fired each type of ammunition and the median number of rounds of each ammunition type that was fired during FY87. Unit commanders were asked about the amount of ammunition that was fired by the unit, but not about ammunition that was fired individually. As expected from the types of aircraft flown by the component units, the majority of AA aviators fired the 20-mm gun during FY87; the 7.62-mm was fired by more NG aviators than any other gun. The AA aviators generally fired larger amounts of ammunition than the NG aviators, regardless of type. The median number of FFARs fired by the aviators approximates the STRAC authorizations for the respective TRC levels. Only a small number of aviators indicated that they had fired a TOW missile during FY87, and none had fired a

Table 4

Flight Hours Logged by Respondents during FY87 in each Helicopter Type

	Commanders				Aviators			
	Active Army		National Guard		Active Army		National Guard	
Helicopter	n	Mdn	n	Mdn	n	Mdn	n	Mdn
AH-1G	0	0	2	80	0	0	11	45
AH-1S(MC/ECAS)	10	135	0	0	301	123	37	120
AH-1S(MOD/PROD)	4	113	7	50	122	120	78	90
AH-64A	8	124	0	0	81	150	2	94
OH-58	45	120	12	80	11	145	10	123
UH-1C/M	0	0	8	71	0	0	104	100
UH-1H	7	75	8	87	7	111	22	88

Note: The following abbreviations are used in Table 4: n = number of aviators responding to each item; Mdn = the median number of flight hours logged; MC/ECAS = modernized Cobra/ enhanced Cobra armament system; MOD/PROD = modified/ production.

Table 5

Median Rounds of Ammunition Fired by Aviators during FY87

	Active Army		National Guard	
Ammunition	n	Mdn	n	Mdn
7.62 mm	80	4250	113	3000
20 mm	329	900	31	700
30 mm	76	950	4	750
40 mm	68	200	58	200
2.75 in. HE	452	70	145	35
2.75 in. Smoke	102	15	12	6
2.75 in. Illumination	211	10	45	10
TOW Missile	56	1	17	1

Note: The following abbreviations are used in Table 5: n = number of aviators responding to each item; Mdn = the median number of rounds fired by each aviator for each type; mm = millimeters; in. = inch; HE = high explosive; TOW = tube-launched, optically-tracked, wire-guided.

HELLFIRE missile. During most of FY87, there was a moratorium imposed on missile firing as a safety precaution.

Training results. The DA CIR 350-85-4 standards specify the percentages of airframes that must be manned by crew, team, and CALFEX/JAAT qualified aviators for each TRC level. For example, TRC A units must have 75% of their airframes manned by crew qualified aviators and 66% of their airframes manned by team and CALFEX/JAAT qualified aviators. Only 22.7% of the 60 AA commanders who responded indicated that their unit met the DA CIR 350-85-4 standards, and 40% indicated their unit did not meet the standards. Only 5.1% of 38 NG commanders indicated that their unit met the standards, and 64.1% indicated their unit did not meet the standards. The other respondents did not know if their unit met the standards. These results corroborate the findings of an earlier STRAC survey (STRAC, 1987).

The commanders of the 29 AA and 24 NG units that did not meet the standards indicated that the lack of ammunition (82.8% of AA and 62.5% of NG units) was the most common reason for not meeting the standards. Only 23.1% (n = 52) of AA commanders and 33.3% (n = 27) of NG commanders indicated that their unit's ammunition allocation was adequate to maintain their TRC level. Furthermore, 58.3% (n = 60) of AA and 76.9% (n = 26) of NG commanders indicated they could not achieve the 75% crew qualification criterion with their current ammunition allocation.

However, an insufficient allocation of ammunition was not the only problem faced by the units in their gunnery training program; 32.3% (n = 65) of AA and 44.4% (n = 36) of NG respondents indicated their unit had returned ammunition unfired in FY87. The most common reasons for returning unfired ammunition were (a) armament problems, (b) having improper types of ammunition for the unit's weapon systems, (c) low range priority, and (d) range scheduling problems. Aircraft maintenance problems, inclement weather, and an inadequate number of IPs and unit trainers (UTs) also were cited by many NG units.

Gunnery Ranges

As noted above, the availability of gunnery ranges was a problem for many units. Only 38% (n = 71) of AA commanders and 31.3% (n = 32) of NG commanders indicated that sufficient range time was available for all essential training operations. Furthermore the types of available ranges were not optimal. Only 12.1% (n = 533) of AA aviators and 3.2%

(n = 251) of NG aviators indicated that they had fired on a fully instrumented, multipurpose range complex (MPRC). The most common types of ranges used by the units were designed for armor or artillery gunnery, or were general purpose impact ranges. Only a small percentage of the ranges used for aerial gunnery training were designed for or specifically adapted for helicopter gunnery.

On the ranges used by the respondents, the most commonly used method of scoring target effect was an airborne observer. The respondents were asked to rate the adequacy of the target effect scoring at the gunnery ranges used by their units. On a scale of 1 = highly inadequate to 7 = highly adequate, the mean rating for the closest range was 3.40 (SD = 1.59) by 488 AA aviators and 3.1 (SD = 1.71) by 198 NG aviators. The scoring adequacy ratings by unit commanders and the ratings for the second closest ranges were slightly lower than the aviator ratings for the closest range. A large majority of all respondents indicated there was a need to improve the scoring equipment and methods on their ranges.

The median number of trips that the aviators made to the closest range and the number of times that they practiced live fire in FY87 was two for both the AA and NG aviators. The IQR for the number of trips and live-fire opportunities was one to three. Of the 437 AA aviators responding, 95% made four or fewer trips to the closest range during FY87; of the 163 NG aviators responding, 92% made three or fewer trips to the closest range. The median distance to the closest gunnery range was 35 air miles (IQR = 10-100) for 463 AA aviator respondents and 80 air miles (IQR = 50-134) for 163 NG aviator respondents. The second closest range was generally much farther away from the units (60 and 200 air miles for 216 AA and 127 NG aviators, respectively) and was used approximately half as many times as the closest range.

Flight Simulators

There are substantial differences between the AA and NG units in their use of flight simulators for training. Among 79 AA commanders, 88.6% indicated that their units used flight simulation as part of their gunnery program. In contrast, only 38.5% of 39 NG commanders indicated that their unit used simulation for gunnery training. The major reasons for this difference is (a) many of the NG aircraft (e.g., UH-1C/M) do not have a field simulator, and (b) access to the AH-1S FWS simulator is limited. None of the NG units had a simulator located at their installation while 40.3% of the 72 AA commanders responding reported having a flight simulator

available at their installation. Of 32 AA and 11 NG commanders that were not co-located with a flight simulator, the median distance to the closest simulator was 60 (IQR = 35-350) and 240 (IQR = 140-350) surface miles, respectively. Among the respondents that received training in a simulator during FY87, the median number of trips made to the simulator was 5 (IQR = 2 to 11) for AA aviators (n = 412) and 1 (IQR = 1 to 2) for NG aviators (n = 99). Because of their limited utilization, no further data on simulator training by the National Guard are presented in this summary.

The AA aviators were asked a series of questions about the training they accomplished in flight simulators. When asked which training device simulated their primary aircraft, 416 indicated the AH-1S FWS, 87 indicated the AH-64 Combat Mission Simulator (CMS), and 6 indicated the UH-1 Flight Simulator (UH-1FS); the remaining aviators either did not respond or indicated that a simulator did not exist for their primary aircraft.

The AA aviators (n = 466) reported logging a median of 20 hours (IQR = 10 - 30) in the flight simulator for their primary aircraft during FY87. The annual simulator training requirements are 20 hours for UH-1 and AH-1 aviators and 30 hours for AH-64 aviators, although these requirements may be reduced or waived (e.g., for IPs or if there is no simulator at the installation). In addition, 440 aviators reported spending a median of 50% (IQR = 20 - 70) of their simulator hours on weapons system training. Finally, 160 of 448 AA aviators reported using the simulator to qualify on their primary aircraft's weapon systems.

The respondents also were asked to rate the training value of the flight simulator for 12 types of training: weapons system switchology, compensating for interior ballistics, compensating for exterior ballistics, compensating for terminal ballistics, target detection, target identification, estimating range to targets, target handover techniques, normal flight tasks, instrument flight tasks, emergency flight tasks, and weapons system emergency procedures. The respondents used a rating scale that ranged from 1 = very low training value to 7 = very high training value.

The commanders and aviators rated the AH-1FWS, AH-64CMS, and UH-1FS (combined ratings) as having relatively high training value for the procedural tasks (e.g., weapons system switchology), but relatively low training value for tasks that are dependent upon the visual cues provided by the simulator (e.g., target identification; estimating range to the target). On other types of training, the respondents did

not exhibit a clear consensus on the simulator's value. For example, the ratings on target handover techniques (see Figure 1) are approximately evenly distributed across the rating categories for both commanders and aviators. This effect may be due to differences in the manner in which different units use the simulators, rather than the inherent value of the simulator for training (G. L. Kaempf, personal communication, January 1988).

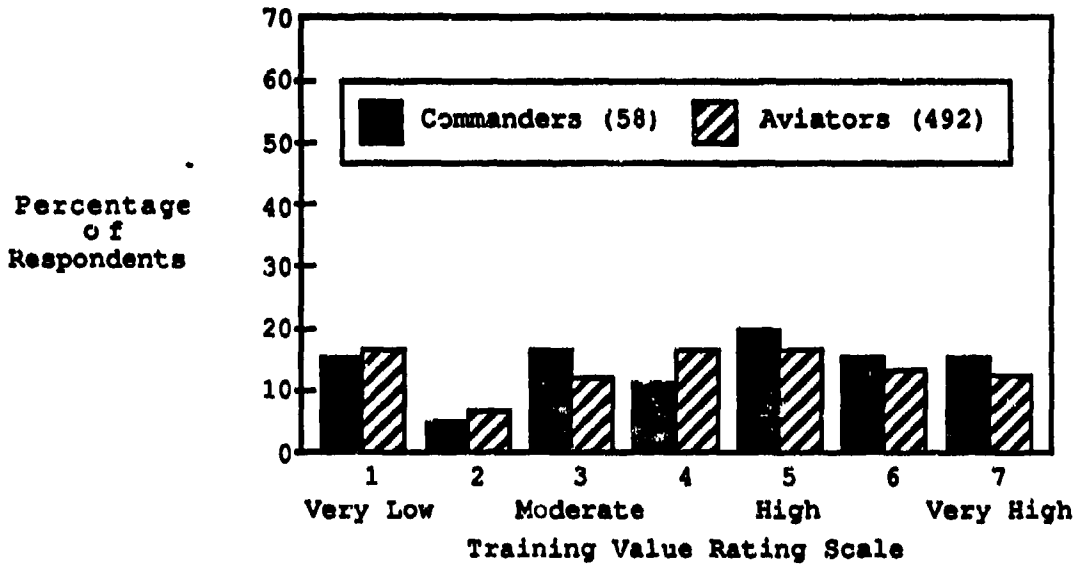

Figure 1. Active Army ratings of the training value of simulators for target handover techniques.

The training value ratings were analyzed separately for the FWS and the CMS simulators. There are no significant differences in the ratings between the two simulators on four types of training (normal flight tasks, emergency flight tasks, weapons system switchology, and weapons system emergency procedures). However, the FWS was rated as significantly better than the CMS on instrument tasks and procedures (t (496) = -6.70, $p < .001$), and the CMS was rated as significantly better than the FWS for the remaining seven types of training. The greatest differences in the ratings are for target detection (t (495) = 11.29, $p < .001$) and target identification (t (495) = 11.27, $p < .001$), which are highly dependent on the simulator's visual system capabilities. Although the ratings are significantly higher for the CMS than the FWS, there is still no strong consensus among the aviators on the training value of the simulator for training target handover techniques.

Finally, the FWS ratings were analyzed to determine if their perceived training value differed as a function of the fidelity between the primary aircraft of the aviator and the simulator. The ratings provided by the AH-1S(MC/ECAS) aviators are significantly higher than the ratings provided by the AH-1S(MOD/PROD) aviators on two training tasks: weapons system switchology (t (379) = -5.19, $p < .001$) and weapons system emergency procedures (t (378) = -3.73, $p < .001$). For these two types of training, performance is apparently dependent on the degree of physical fidelity between the simulator and the aircraft. There were no significant differences in the ratings between the two groups of aviators on the other ten types of training.

Estimated Training Requirements

The survey respondents were asked several opinion questions about the training requirements for attack helicopter aviators. Three sets of opinion questions are discussed in this summary: (1) the need for gunnery tables, (2) the estimated minimum amounts of ammunition needed for crew qualification, and (3) the estimated minimum amounts of ammunition needed to sustain an aviator's gunnery skills for a 12-month period.

Need for gunnery tables. A majority of the respondents did not desire a standardized gunnery training program, but agreed on the need for standardized gunnery tables to support the development of unit training programs. That is, the respondents want the flexibility to tailor their own unit gunnery training programs, but most respondents recognize the need for training program guidelines.

Table 6 shows the percentage of respondents who agreed and disagreed on the need for standardized individual gunnery tables. The responses to questions about crew tables and unit mission tables were very similar to the individual table question: the majority were in favor of having the tables, although the NG respondents were slightly less favorable than the AA respondents and the aviators were slightly less favorable than the unit commanders. A large majority of respondents also wanted live-fire practice tables and mandatory simulation tables.

Table 6

Percentage of Respondents Agreeing on the Need for Standardized Individual Tables

Commanders	% Strongly Agree	% Moderately Agree	% Moderately Disagree	% Strongly Disagree
Active Army (n = 76)	36.8	28.9	18.4	15.8
National Guard (n = 37)	21.6	48.6	18.9	10.8
Aviators	**% Strongly Agree**	**% Moderately Agree**	**% Moderately Disagree**	**% Strongly Disagree**
Active Army (n = 525)	27.8	35.0	22.3	14.9
National Guard (n = 223)	20.6	38.1	24.2	17.0

Crew qualification ammunition requirements. The respondents were asked to estimate the minimum number of rounds of each type of ammunition needed for an average aviator to achieve crew qualification. Because of the differences in weapon systems on the various aircraft assigned to the units, there are large differences in the number of respondents to each item. If there were 15 or fewer respondents to an item, the data were considered unreliable and were not analyzed. Nonetheless, reasonable estimates were obtained for most types of ammunition.

As shown in Tables 7, 8, and 9, the commanders tended to have slightly higher estimates than the aviators of the number of 7.62-, 20-, and 40-mm rounds that are needed for crew qualification. The estimates are substantially higher than the median number of rounds fired in FY87 (see Table 5). Reliable estimates of the number of 30-mm rounds were obtained only from AH-64 aviators (see Table 10).

Table 7

Estimated Minimum Number of 7.62-mm Rounds Required for an Average Aviator to Achieve Crew Qualification

Commanders	Day	Night	NVD	Total
Active Army				
Mdn	--	--	--	--
IQR	--	--	--	
n	12	10	9	
National Guard				
Mdn	6000	3000	--	--
IQR	3000-12000	1800-6000	--	
n	24	21	11	
Aviators	**Day**	**Night**	**NVD**	**Total**
Active Army				
Mdn	3000	1500	1500	6000
IQR	1200-4000	1500-3000	1000-3000	
n	80	73	66	
National Guard				
Mdn	4000	2000	3000	9000
IQR	2000-6000	1500-6000	1500-6000	
n	158	145	124	

Note: The following abbreviations are used in Table 7: mm = millimeter; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data ($n < 15$) to compute statistics.

Table 8

Estimated Minimum Number of 20-mm Rounds Required for an Average Aviator to Achieve Crew Qualification

Commanders	Day	Night	NVD	Total
Active Army				
Mdn	750	600	500	1850
IQR	500-1200	300-1000	200-800	
n	40	39	38	
National Guard				
Mdn	--	--	--	--
IQR	--	--	--	
n	1	1	1	
Aviators	**Day**	**Night**	**NVD**	**Total**
Active Army				
Mdn	600	500	500	1600
IQR	400-1000	300-1000	300-1000	
n	335	322	298	
National Guard				
Mdn	1000	1000	1000	3000
IQR	400-2000	400-1500	400-1500	
n	38	35	33	

Note: The following abbreviations are used in Table 8: mm = millimeter; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data ($n < 15$) to compute statistics.

Table 9

Estimated Minimum Number of 40-mm Rounds Required for an Average Aviator to Achieve Crew Qualification

Commanders	Day	Night	NVD	Total
Active Army				
Mdn	--	--	--	--
IQR	--	--	--	
n	12	10	8	
National Guard				
Mdn	300	250	--	--
IQR	200-500	100-300	--	
n	19	17	8	
Aviators	**Day**	**Night**	**NVD**	**Total**
Active Army				
Mdn	300	225	200	725
IQR	150-500	100-400	150-400	
n	76	64	59	
National Guard				
Mdn	300	200	200	700
IQR	100-500	100-500	100-500	
n	128	118	104	

Note: The following abbreviations are used in Table 9: mm = millimeter; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data ($n < 15$) to compute statistics.

Table 10

Estimated Minimum Number of 30-mm Rounds Required for an Average Aviator to Achieve Crew Qualification

Commanders	Day	Night	NVD	Total
Active Army				
Mdn	--	--	--	--
IQR	--	--	--	
n	8	5	8	
National Guard				
Mdn	--	--	--	--
IQR	--	--	--	
n	0	0	0	
Aviators	**Day**	**Night**	**NVD**	**Total**
Active Army				
Mdn	500	500	500	1500
IQR	300-1000	300-750	300-1000	
n	81	56	81	
National Guard				
Mdn	--	--	--	--
IQR	--	--	--	
n	5	5	5	

Note: The following abbreviations are used in Table 10: mm = millimeter; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

Table 11 presents the estimated minimum number of High Explosive (HE) FFARs required for day, night-unaided, and night vision device qualification. Compared to the unit commanders, the aviators generally estimate that more FFARs are required for crew qualification. There is close agreement between the AA and NG aviators and between the AA and NG commanders on the number of FFARs needed for crew qualification. The ranges of the estimates indicate there is more agreement among commanders than among aviators on the number of FFARs that are needed. This pattern also occurs in the estimates of the number of TOW missiles that are needed to qualify (see Table 12). There is much closer agreement among all subgroups on the estimated minimum requirements for 2.75-inch smoke and illumination FFARs (see Table 13).

Skill sustainment ammunition requirements. In questions that are similar to the crew qualification items, the respondents were asked to estimate the minimum number of rounds of each type of ammunition needed to sustain an average aviator's gunnery skills for a 12-month period. Table 14 presents the estimated sustainment requirements for the 7.62-, 20-, 30-, and 40-mm guns. Where comparisons can be made, there is generally good agreement in the estimates between AA and NG, and between aviators and commanders. With the exception of 30-mm ammunition, the median estimated sustainment requirements are less than the total estimated crew qualification requirements.

Table 15 presents the median sustainment estimates for the 2.75-inch HE, smoke, and illumination FFARs. For all three types of FFARs, the aviators generally estimate a higher sustainment requirement than the unit commanders. The generally smaller ranges of estimates indicate a better consensus among the commanders than among the aviators in their opinions on the ammunition requirements for skill sustainment. The estimates are much higher for the AA than the NG, but this result probably reflects the differences in training readiness conditions. The median gunnery skill sustainment estimates approximate the annual STRAC authorizations per airframe for all levels of gunnery training (i.e., individual, crew, team, and CALFEX/JAAT).

As shown in Table 16, the aviators' estimates for missile skill sustainment are substantially higher than the current authorizations (.9 TOW missiles per airframe and no HELLFIRE missiles). Very little reliable data were obtained from the commanders on skill sustainment requirements for the TOW and HELLFIRE missiles.

Table 11

Estimated Minimum Number of 2.75-inch HE Rockets Required for an Average Aviator to Achieve Crew Qualification

Commandars	Day	Night	NVD	Total
Active Army				
Mdn	40	32	32	104
IQR	32-76	20-50	24-50	
n	57	52	52	
National Guard				
Mdn	60	30	--	--
IQR	28-112	20-56	--	
n	25	22	12	
Aviators	**Day**	**Night**	**NVD**	**Total**
Active Army				
Mdn	50	48	48	146
IQR	30-100	25-100	25-100	
n	486	443	440	
National Guard				
Mdn	50	50	50	150
IQR	36-100	25-76	24-100	
n	185	170	151	

Note: The following abbreviations are used in Table 11: HE = high explosive; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

Table 12

Estimated Minimum Number of Missiles Required for an Average Aviator to Achieve Crew Qualification

	TOW MISSILES			HELLFIRE MISSILES		
Commanders	DAY	NIGHT	NVD	DAY	NIGHT	NVD
Active Army						
Mdn	2	1	1	--	--	--
IQR	1-2	1-2	1-2	--	--	--
n	45	34	26	7	2	7
National Guard						
Mdn	--	--	--	--	--	--
IQR	--	--	--	--	--	--
n	12	9	4	0	0	0

	TOW MISSILES			HELLFIRE MISSILES		
Aviators	DAY	NIGHT	NVD	DAY	NIGHT	NVD
Active Army						
Mdn	2	2	2	2	2	2
IQR	1-3	1-4	1-4	1-4	1-5	1-5
n	358	276	226	69	34	68
National Guard						
Mdn	2	3	4	--	--	--
IQR	1-5	2-5	2-5	--	--	--
n	99	79	65	9	7	7

Note: The following abbreviations are used in Table 12: NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

Table 13

Estimated Minimum Number of Smoke and Illumination Rockets Required for an Average Aviator to Achieve Crew Qualification

Commanders	Smoke (Day)	Illum (Night)	Illum (NVD)
Active Army			
Mdn	10	12	10
IQR	8-20	10-20	6-16
n	41	47	40
National Guard			
Mdn	--	14	--
IQR	--	7-24	--
n	14	22	9

Aviators	Smoke (Day)	Illum (Night)	Illum (NVD)
Active Army			
Mdn	16	18	16
IQR	10-30	10-30	10-30
n	278	348	301
National Guard			
Mdn	12	14	14
IQR	10-25	10-25	10-25
n	90	121	97

Note: The following abbreviations are used in Table 13: Illum = illumination; NVD = night vision device; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

Table 14

Estimated Minimum Number of Rounds Needed to Sustain an Average Aviator's Skills for 12 Months

Commanders	7.62-mm	20-mm	30-mm	40-mm
Active Army				
Mdn	--	1000	--	--
IQR	--	600-2000	--	--
n	13	41	8	13
National Guard				
Mdn	6000	--	--	300
IQR	3000-9000	--	--	200-500
n	28	2	0	22
Aviators	**7.62-mm**	**20-mm**	**30-mm**	**40-mm**
Active Army				
Mdn	6000	1500	2000	500
IQR	4000-12000	1000-2500	1000-3200	300-1200
n	84	357	85	80
National Guard				
Mdn	5000	1000	--	300
IQR	3000-10000	600-2000	--	200-800
n	177	37	6	142

Note: The following abbreviations are used in Table 14: mm = millimeter; Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

Table 15

Estimated Minimum Number of 2.75-inch Rockets Needed to Sustain an Average Aviator's Gunnery Skills for 12 Months

Commanders	HE	Smoke	Illum
Active Army			
Mdn	100	14	20
IQR	50-200	10-30	8-48
n	60	47	54
National Guard			
Mdn	60	14	10
IQR	38-100	6-14	6-14
n	29	17	25
Aviators	**HE**	**Smoke**	**Illum**
Active Army			
Mdn	160	30	30
IQR	100-300	20-60	20-50
n	514	330	418
National Guard			
Mdn	76	14	14
IQR	50-152	10-40	10-30
n	203	111	146

Note: The following abbreviations are used in Table 8: HE = high explosive; Illum = illumination; Mdn = median; IQR = interquartile range; n = number of respondents.

Table 16

Estimated Minimum Number of Missiles Needed to Sustain an Average Aviator's Skills for 12 Months

Commanders	TOW MISSILES	HELLFIRE MISSILES
Active Army		
Mdn	2	--
IQR	1-3	--
n	49	8
National Guard		
Mdn	--	--
IQR	--	--
n	13	0

Aviators	TOW MISSILES	HELLFIRE MISSILES
Active Army		
Mdn	3	3
IQR	2-5	2-6
n	403	80
National Guard		
Mdn	3	--
IQR	2-5	--
n	109	8

Note: The following abbreviations are used in Table 16: Mdn = median; IQR = interquartile range; n = number of respondents; -- = insufficient data (n < 15) to compute statistics.

SUMMARY AND CONCLUSIONS

The Ammunition and Gunnery Survey research was conducted to establish an empirical information data base on U.S. Army and National Guard attack helicopter aviators and units. The following types of information are included in the data base:

- the demographic characteristics of the aviators and units,
- the allocation and utilization of ammunition to aviation units,
- the availability and utilization of gunnery ranges for aviation training,
- the availability and utilization of flight simulators for aviation training,
- the estimated resource requirements for effective gunnery training, and
- ancillary issues in aviation gunnery training.

The data base is intended to support the requirements for both current and future Army and National Guard aviation gunnery analyses. The current requirements are to (a) formulate justifiable ammunition requests for helicopter gunnery training, (b) revise the FM 1-140 Helicopter Gunnery manual, and (c) evaluate the availability and utility of gunnery ranges and training simulators. Further analyses of the data base will be conducted as additional questions about attack helicopter training are raised. The information collected during this survey also serves as a baseline for comparison with future data collection efforts.

Several conclusions can be drawn from the survey results, especially with respect to the major problem areas addressed in the current analyses. Each general conclusion is discussed in the following paragraphs.

1. The return rates and distribution across major commands of usable surveys are adequate to provide a reliable data base for analysis, although there are limitations on the number of subsample analyses that can be conducted reliably. The amount and quality of the data collected are especially satisfactory when considering the length and detail of the surveys and the short suspense that was provided for completing them. In addition, some of the current results are corroborated by the findings of a previous, though less comprehensive, ammunition survey (STRAC, 1987).

2. The AA respondents are, on the average, relatively young and inexperienced in the performance of their occupational specialty. This is a factor that should be considered in

determining the types and amounts of training that are provided. The NG aviators generally are older and have more experience than their AA counterparts, and therefore may be better able to sustain their skills at acceptable TRC levels with less training resources. However, proportionately more of the NG aviators are maintaining their gunnery skills in aging and less effective attack aircraft (e.g., AH-1G, UH-1C/M, UH-1H). Although slightly younger, the AA commanders have experience levels that are approximately equal to the NG commanders.

3. Although the average AA aviator flew slightly more than the minimum number of hours required to maintain his flight skills in FY87, he fired less than the STRAC-authorized number of rounds of ammunition. The average NG aviator generally logged fewer flight hours and fired less ammunition than his AA counterpart. The median number of NG flight hours is consistent with previous research on the utilization of NG aviator training time (Ruffner & Szabo, 1986). The lower ammunition expenditures are consistent with the lower TRC level of most NG units.

4. A substantial number of AA and NG attack helicopter units are unable to meet the standards for their TRC with the resources that are currently available to them. In many cases, the respondents indicated that their STRAC ammunition allocation was insufficient to meet the training standards; in other cases, the inability to meet the training standards was attributed to other resource limitations such as a lack of suitable gunnery ranges and resource management issues. The lack of training resources and training time resulted in substantially lower crew qualification levels for the NG than for the AA.

5. Gunnery ranges are not readily available to many units or do not have adequate scoring methods. Many of the closest ranges are at a considerable distance from the unit, and aviators must compete with other branches for range time. Only a small percentage of aviators fired on a fully-instrumented MPRC during FY87. Transportable scoring systems that utilize electronic sensing are currently being developed to meet the need for objective evaluations of gunnery proficiency, but they are not yet in widespread use (G. L. Kaempf, personal communication, January 1988). Finally, very few of the ranges that are used by aviation units were designed specifically for aviation gunnery. All of these problems were especially critical for the NG units.

6. Flight simulators are being used to a moderate extent (median of 10 hours during FY87) by the AA aviators for

gunnery training. In addition, there are several sub-conclusions that can be drawn about simulator use.

a. Very few NG units have access to flight simulators for training, which exacerbates the problems caused by limited access to ranges.

b. The simulators are perceived to have utility for some types of training but not for other types. In particular, tasks that are dependent on the FWS simulator visual system were not rated highly on training value.

c. Aviators who fly the AH-1S(MOD/PROD) configurations rated the training value of the FWS lower on weapons system switchology and weapons system emergency procedures tasks than aviators who fly the AH-1S(MC/ECAS). The lack of physical simulator-to-aircraft fidelity was not judged to impair training on the other training tasks.

d. AH-64 aviators rated the training value of the CMS higher than the AH-1 aviators rated the FWS on 7 of the 12 types of training.

When drawing conclusions about the training value of simulators, it is important to remember that the present data are subjective opinions rather than systematic measures of objective performance. It is not possible to determine from the current data base if low training value ratings should be attributed to the simulator hardware and software, to the manner in which the simulator is utilized for training, or to the aviators' preference for training in the aircraft instead of the simulator.

7. The unit commanders and aviators are in favor of having standardized gunnery tables to support the development of training programs. The ammunition utilization and estimated ammunition requirements data obtained from the survey respondents constitute a source of information that can be used to revise the FM 1-140 tables.

8. The estimates of ammunition requirements indicate that the current STRAC authorizations approximate the minimum number of rounds needed to qualify and sustain the average aviator's gunnery skills. It is very important to remember, however, that these estimates are based on personal opinions of the aviators and commanders and not on empirical studies in which training resources are systematically varied and aviator proficiency is objectively measured. The validity of the estimates is supported by the data on the number of rounds fired (less than authorized) and the concomitant percentage of units that do not meet the TRC standards.

9. It is not sufficient for the units to receive the full authorization of ammunition; the units must have adequate access to ranges and the operational aircraft and weapon systems needed to expend the ammunition. Well conceived training and evaluation programs also are required to ensure that the maximum benefit is received from the gunnery training.

10. Finally, further research is needed to evaluate and improve the training of attack helicopter aviators. Additional analyses can be conducted with the current data base, and longitudinal survey data can be collected to evaluate the effects of changes in resources and training programs. Most importantly, the results of the Ammunition and Gunnery Survey have generated hypotheses that should be tested experimentally (e.g., that flight simulators could be used more effectively than they are currently being employed). ARIARDA currently is planning to conduct experimental studies on the utility of the FWS simulator for training gunnery tasks (G. L. Kaempf, personal communication, January 1988). These empirical studies are needed to determine the amount, frequency, and type of training required to ensure that U.S. Army and National Guard attack helicopter units are capable of accomplishing their missions.

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